Investigation of diffuser influence in near-field ptychography

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Ptychography is a coherent diffractive imaging technique [1] utilizing a scanning transmission microscopy setup where overlap redundancy of the incident illumination between adjacent scan points is used to reconstruct iteratively both the object's transmission function and the scanning illumination profile [2]. Near-field ptychography, a novel modality of this technique using Fresnel diffraction patterns, was recently demonstrated [3]. The method has been applied to strongly phase shifting samples [4] and in conjunction with nanotomography [5]. Benefits of near-field ptychography include large fields of view and absence of wavefront corrections since wavefront imperfections are explicitly required by the reconstruction approach. In fact, additional distortions are introduced into the scanning beam with the aid of a diffuser to generate more diversity. The influence of the diffuser on the reconstruction process has yet to be investigated and is at the center of our research as we further explore the possibilities of this new technique. We present the results of a diffuser study carried out at the coherence beamline I13-1 at Diamond Light Source. A Siemens star test pattern was imaged with different diffuser materials in the beam and their influence on the reconstruction process was investigated. In addition, the effect of translating the diffusers along the optical axis was examined. Our findings are supplemented with visible light measurements. We acknowledge financial support through the European Research Council (ERC, starting grant "OptImaX").

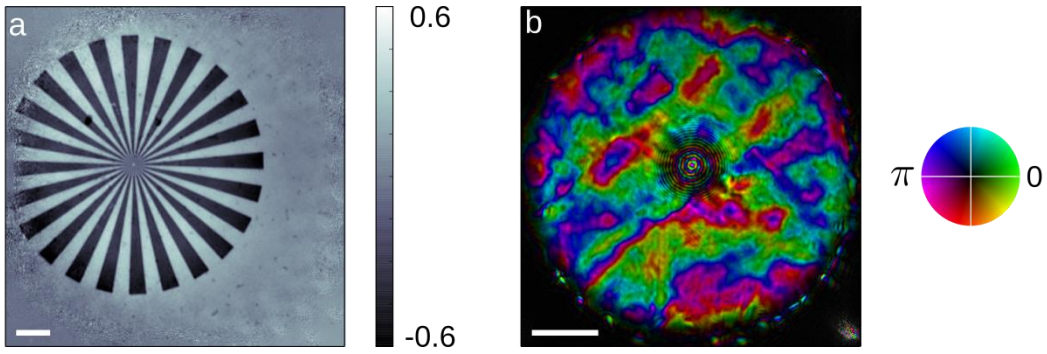

Figure: Reconstructed phase shift of a Siemens star test pattern (a) and corresponding complex-valued illumination function distorted by a weak cardboard diffuser (b). Scale bars indicate 20 µm.

References

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